The Use of Blood at a Large Red Cross Center

An Evaluation of Various Aspects of Utilization

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• **During the past ten years over 1,000,000 pints of blood have been collected at the Los Angeles Regional Red Cross Blood Center.**

In addition to the progressive increase in the number of whole blood transfusions there has been a greater use of specific blood elements which results in purposeful and economical hemotherapy.

With the increased use of blood there has also been a growing awareness of transfusion reactions and dangers. Serious transfusion complications reported have been due to bacterial contamination, to hemolytic reactions, to homologous serum jaundice, and to a mistake in cross-matching.

Surgeons and anesthetists must pay strict attention to the use of blood since anesthesia masks severe hemolytic transfusion reactions.

At present there is no way of eliminating the danger of the transmission of virus disease (infectious hepatitis and homologous serum jaundice) in blood transfusions.

THE FIRST HOSPITAL BLOOD BANK in this country was started in 1936 at the Cook County Hospital in Chicago. With the increased demand for blood each year since then and with the impetus from the experience of World War II, a natural development was the creation of Community Blood Centers to obtain and offer adequate blood supplies.

The Los Angeles Regional Blood Center, which conducts one of the largest community blood programs, is sponsored jointly by the Los Angeles County and the Orange County medical associations and the American National Red Cross (21 participating chapters of the Red Cross).

Located in a medical center having three medical schools, this program is fortunate in having pathologists, hematologists and internists with wide experience and interest in the blood field as active members of advisory committees of the county medical societies' Blood Center. With the technical supervision given by these advisors and with the strictest conformity to the regulations of the Biologics Division of the California State Health Department and the National Institutes of Health, it is felt that the Los Angeles Regional Blood Center is providing as safe a bottle of blood as is possible.

The yearly increase in collections for civilian use from 1946 through 1955 is shown in Table 1.

The continuous increase in the use of blood by civilian hospitals in the community coincided with a tremendous growth of population in the area, but at the same time there was also a definite increase in the use of blood per hospital bed. In 1948 an average of four to five pints of blood was used annually per hospital bed; in 1955 the average was approximately ten pints.

The community blood center has also made available liquid plasma, frozen plasma and blood fractions. The distribution of these derivatives during the past three years is as follows:

Derivative	1953	1954	1955
Antihemophilic plasma (50 cc.)	312	1,826	4,658
Frozen plasma (250 cc.)	90	90	92
Liquid plasma (350 cc.)	1,877	441	355
Red blood cells (250 cc.)	804	710	877
Serum albumin (20 cc.)	139	77	108
Serum albumin (100 cc.)	250	553	948

The decreased use of liquid plasma is due to its restricted availability since most of the blood that is collected by the Red Cross and not used as whole blood is converted into blood fractions.

Fibrinogen was made available to the Los Angeles Red Cross Blood Center in the fall of 1953. Since that time, 24 units of it has been distributed for use in specific cases.

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TABLE 1.—*Yearly Increase in Collections of Blood for Civilian Use by the Los Angeles Regional Blood Center*

Year	Pints Collected	For Civilian Use	To Department of Defense
1946	4,217	4,217	.....
1947	11,281	11,281	.....
1948	21,123	21,123	.....
1949	45,693	45,693	.....
1950	84,570	72,266	12,404
1951	197,432	93,315	104,117
1952	203,444	102,179	101,265
1953	196,359	110,305	86,054
1954	167,154	120,453	46,701
1955	144,291	133,274	11,017
Totals	1,075,664	714,106	361,558

As knowledge of their uses and the availability of blood fractions develop, the trend will be for the use of the blood element specifically needed for the particular patient. In many instances, the administration of red cells is indicated for anemia and the giving of whole blood is at best wasteful and may even be harmful. A patient with bleeding due to afibrinogenemia will be given only fibrinogen; one with a deficiency in gamma globulin will receive only gamma globulin; one with nephrosis will be given only serum albumin; and one with hemophilia will receive only frozen plasma or antihemophilic plasma. This will result in purposeful and economical hemotherapy.

The use of blood as a therapeutic agent is still in its infancy. With the increased use of blood, resulting in the saving of many lives, there has also been a proportionate increase in transfusion reactions, accidents and iso-immunization problems. Recent reports estimate the mortality from blood transfusions to be approximately one death in 1,000 to 3,000 transfusions. Considering that about 3,500,000 transfusions are given yearly, the number of deaths would be about 1,750, which would make blood transfusion as important a cause of death as appendicitis or anesthesia.[8]

It is the policy of the Los Angeles Regional Blood Center to have the hospitals report their transfusion reactions to it each month. The milder allergic and pyrogenic reactions reported to the Blood Center are usually of minor consequence. To illustrate, below is a recapitulation of the experience in the past three years at the Children's Hospital, Los Angeles:

Year	No. Units Blood	Reactions	
		Number	Per Cent
1953	1,762	44	2.5
1954	1,749	57	3.26
1955	2,077	50	2.4

With care taken in the medical history of the donor, one rarely hears of the transmission of malaria or infectious diseases. In blood-banking there need not be too much concern with the transmission of syphilis, since the Treponema pallidum cannot survive 72 hours at 4° to 10°C. In the select group of donors who voluntarily donate blood through the Red Cross Regional Center, the proportion who have serologic tests positive for syphilis is comparatively small. Of 136,587 serologic tests performed in 1955, the number positive for syphilis was 212, or 0.15 per cent.

In spite of the use of disposable sterile equipment, bacteriological surveys quoted in other publications have shown as high a proportion as five to ten per cent of specimens of bank blood to be contaminated with bacteria. The bacterial contaminants in most cases are Gram-positive, do not grow at refrigerator temperature and are nonpathogenic. Where pathogenic bacterial contamination has caused death, the organisms have been either of the Pseudomonas or of the coli-aerogenes groups.[8] The Los Angeles Center has had reported to it one fatal reaction caused by bacterial contamination. The contamination was in a bottle of blood which had been sent from a blood center in another state.

The greatest number of deaths from blood transfusions are caused by the administration of incompatible blood. Noncompatible blood produces intravascular hemolysis resulting in chills, high fever, nausea, pain in the lumbar area and legs, and a sensation of substernal constriction and throbbing headache. The pulse rate increases, the respirations become labored and rapid, and signs of circulatory collapse may last from a few minutes to 24 hours. Jaundice and anuria of varied severity occur.

Under anesthesia these symptoms of hemolytic reactions are absent, but there may be an increase of blood oozing into the operative wound, and duskiness of the skin usually occurs. This increased hemorrhagic tendency has sometimes been referred to as exsanguination purpura.[2]

It is important to know the cause of the reaction. In suspected hemolytic or incompatibility reactions, the cause can be determined by checking the pretransfusion and posttransfusion specimens of the patient's blood with the donor's blood.

The clinician or surgeon depends entirely on the laboratory for all the important tests to determine the compatibility and safety of the blood for the patient. Not only must he rely on the technical staff but also on many nontechnical personnel who carry the blood about the laboratory and to the wards or operating rooms.

One fatality reported to the Los Angeles Center occurred because of a mistake in cross-matching. Two pints of Group AB blood were administered to a Group B patient on whom a cesarean section was performed, resulting in the patient's death one week following the blood transfusions. Most fatal mistakes are really the result of human error, which is a matter of constant anxiety to anyone having the responsibility of running a blood bank.

Because of the dangers associated with blood transfusions, the use of blood should be restricted to circumstances in which there are direct, specific and definite indications.

A number of surgeons have become enthusiastic about giving blood during operation both to prevent possible shock and to replace blood that may be lost. This, combined with the anesthetist's desire to maintain a stable graph of blood pressure and pulse during operation, has in many instances resulted in

an unnecessary use of blood, with increased danger to the patient. All too frequently an anesthetist gives a blood transfusion to a patient undergoing a cholecystectomy, mastectomy, hysterectomy or other operative procedure associated with little blood loss, even though the preoperative blood determinations were within normal limits. Sometimes when the loss of blood at operation is not great the surgeon will sanction a transfusion rather than return blood to the laboratory.

As was pointed out previously, the special hazard of giving blood during anesthesia is that the usual signs of serious transfusion reactions are masked or suppressed. It is important that surgeons and anesthetists evaluate seriously the necessity of administering blood during anesthesia and limit the use of blood to those patients who have excessive loss.

Sometimes preoperatively and frequently postoperatively, a surgeon, following a natural desire to return a patient's blood count to normal as rapidly as possible, will administer blood when a similar result could be brought about with greater safety, although more slowly, by other means.

Overloading the circulation is another example of the misuse of blood. It was reported to the Blood Center that a 69-year-old woman with chronic anemia received six units of blood within 48 hours, resulting in congestive failure. If transfusion is indicated in patients of this type and in the aged, speed of administration should be reduced; and packed cells instead of whole blood may be used to great advantage.[3]

Because of large volume transfusions in major operations and the increased knowledge of electrolytes, the question of citrate intoxication has been raised. Citrate in excessive amounts lowers ionized calcium, which may result in tetany and cardiac dysfunction. Normally one is not too concerned, because of the considerable margin of safety. However, in patients with impaired liver function, citrate intoxication is possible and the administration of 10 cc. of 10 per cent calcium gluconate into another vein for each two bottles of transfused blood is wise.[6]

One of the most serious dangers is that of transmitting hepatitis to the patient. Reports indicate that this may occur in about one of 200 patients receiving transfusions of whole blood and that death may be caused by this factor in about one case in 6,000 transfusions.[2] Generally, the incidence of hepatitis following whole blood transfusion seems to be less than one per cent. This danger is greater, however, following transfusions of plasma[5,6,8] although recent work has demonstrated that the virus of this disease will not survive in liquid plasma stored at room temperature for long periods (six to nine months).[1] For the past five years at the Los Angeles Blood Center, irradiated pooled liquid plasma has been stored in that manner.

During World War II, in one careful follow-up study of 587 wounded soldiers in three Army hospitals, it was found that in 21.9 per cent of those who received blood and plasma, hepatitis with jaundice developed. This was in contrast to an incidence of 3.6 per cent among those who received whole blood only (5.6 units of whole blood per patient—hence the comparatively high incidence).[7]

The danger of virus hepatitis is universal. In Copenhagen in 1951, the incidence of virus hepatitis among 4,687 hospital patients, about one year after their discharge, was 1 per cent among those who had received whole blood transfusions; 3 to 4 per cent among those who had received serum transfusions; and 0.14 per cent among those in the control group. (There is always the possibility that the infection might have resulted from contaminated syringes, needles or blood lancets used in the hospital.)[4]

There are two virus agents concerned in the transmission of hepatitis. The two diseases produced clinically are much alike and from the pathological point of view are almost identical. One has been identified primarily with the clinical and epidemiological syndrome of infectious hepatitis and has an incubation period of approximately 20 to 40 days. The other, which has been associated with the homologous serum hepatitis syndrome, characteristically develops 60 to 150 days after blood transfusion.

Most studies have shown that an attack of one disease confers some immunity to that disease but not to the other. It has been demonstrated that gamma globulin may prevent epidemics of infectious hepatitis when given during the incubation period.

At the Los Angeles Regional Red Cross Blood Center, we have been concerned with the increased number of posttransfusion hepatitis cases—15 cases reported in 1954 and 34 cases in 1955. Only the serious cases are reported to the Center in the monthly reports from hospitals. Actually the incidence is many times as great as the reports would indicate.

Of particular importance is that volunteer donors are carefully screened, and when a donor's blood is implicated in a case of jaundice, a letter is written to the donor explaining the situation and asking if he had understood the original query concerning a history of jaundice. In only one such case was there implication of previous overt hepatitis: Upon review of his medical history the donor mentioned that he had been hospitalized while in the Army with several other patients and that the diagnosis may have been infectious hepatitis, although he was

not jaundiced and was not certain that the illness was hepatitis. However, on the chance that this donor had had infectious hepatitis, we asked him not to donate blood again. As to the cases of the many who have replied stating very definitely that there was no history of jaundice, the obvious conclusion is that there are asymptomatic carriers and that there is as yet no way of eliminating the hazard of virus disease transmission in blood transfusion.

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